

CLAIMS

What is claimed is:

- 5 1. An object tracking system for tracking the removal of objects from a storage unit and the replacement of the objects at a storage unit, said object tracking system comprising:
 - an ID tag attached to each of the object to be tracked, each ID tag including electronic storage means carrying a stored code associated with the object corresponding to the ID tag, each of said ID tags transmitting its stored code when said ID tag is appropriately activated;
 - 10 a plurality of receptacles in said storage unit configured to receive objects when objects are replaced in said storage unit and to allow the objects to be selectively removed from the storage unit;
 - 15 a sensor associated with each of said receptacles for activating the ID tag of an object in said receptacle and detecting the resulting transmission by the ID tag of the stored code associated with the object;
 - 20 selection circuitry coupled to said sensors for successively selecting said sensors, each sensor, when selected, detecting the stored code associated with an object if an object is present in the corresponding receptacle and detecting no code if an object is not present in the corresponding receptacle; and
 - 25 a controller coupled to said sensors for receiving stored codes detected by said sensors and for determining, based on the received codes, the absence of objects removed from the location and the presence and location within the storage unit of objects present at the location;
- said ID tags being adapted to transmit their stored codes to said sensors.
2. An object tracking system as claimed in claim 1 and wherein said ID tags are radio frequency identification (RFID) tags, the stored codes of said ID tags being transmitted to said sensors through radio frequency transmission.

3. An object tracking system as claimed in claim 2 and wherein each of said ID tags includes an antenna for transmission of its stored code and wherein each of said sensors includes an antenna for receiving stored codes transmitted by said ID tags.

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4. An object tracking system as claimed in claim 3 and wherein said antenna of each ID tag comprises a pair of capacitive plates and wherein each of said sensors includes a pair of capacitive plates, said capacitive plates of each ID tag aligning with said capacitive plates of a sensor when the object to which said 10 ID tag is attached is disposed in the receptacle associated with the sensor, the radio frequency transmission of said ID tag being capacitively coupled to said sensor.

5. An object tracking system as claimed in claim 4 and wherein said 15 capacitive plates are formed of conductive foil.

6. An object tracking system as claimed in claim 4 and wherein said capacitive plates are formed of resistive ink.

20 7. An object tracking system as claimed in claim 4 and wherein said capacitive plates are applied to a surface of said object.

8. An object tracking system as claimed in claim 4 and wherein said capacitive plates are embedded within said object.

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9. An object tracking system as claimed in claim 4 and wherein said storage unit includes a panel formed with openings defining said receptacles and a backplane spaced from and juxtaposed said panel, said capacitive plates of said sensors being mounted on said backplane.

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10. An object tracking system as claimed in claim 9 and wherein the objects are relatively thin cards having a length, a width, and a face, said capacitive plates of each ID tag being substantially parallel with the face of its corresponding card and said capacitive plates of each sensor being formed on an 5 upstanding daughter board affixed to said backplane.

11. An object tracking system as claimed in claim 10 and wherein said capacitive plates of each ID tag is disposed on the face of a corresponding card.

10 12. An object tracking system as claimed in claim 10 and wherein said capacitive plates of each ID tag are embedded within a corresponding card.

15 13. An object tracking system as claimed in claim 10 and wherein the capacitive plates of each ID tag are oriented along the width of the corresponding card and wherein the capacitive plates of said sensors are correspondingly oriented to align with the capacitive plates of said ID tags.

20 14. An object tracking system as claimed in claim 10 and wherein the capacitive plates of each ID tag are oriented along the length of the corresponding card and wherein the capacitive plates of said sensors are correspondingly oriented to align with the capacitive plates of said ID tags.

25 15. An object tracking system as claimed in claim 9 and wherein the objects are relatively thick and have a bottom end that is inserted in a selected receptacle when the object is placed in said storage unit, said capacitive plates of each ID tag being substantially parallel with the bottom end of the corresponding object and said capacitive plates of said sensors being formed on said backplane.

30 16. An object tracking system as claimed in claim 15 and wherein the objects are openable containers defining an interior space, the bottom ends of the objects have an interior surface and an exterior surface.

17. An object tracking system as claimed in claim 16 and wherein said capacitive plates of each ID tag are disposed on the interior surface of the bottom end of the corresponding openable container.

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18. An object tracking system as claimed in claim 16 and wherein said capacitive plates of each ID tag are embedded within the bottom end of the corresponding openable container.

10 19. An object tracking system as claimed in claim 15 and wherein said backplane has a front surface facing said panel and a back surface facing away from said panel.

15 20. An object tracking system as claimed in claim 19 and wherein said capacitive plates of said sensors are formed on said front surface of said backplane.

20 21. An object tracking system as claimed in claim 19 and wherein said capacitive plates of said sensors are formed on said back surface of said backplane.

22. An object tracking system as claimed in claim 19 and wherein said capacitive plates of said sensors are formed by printed circuit tracings on said backplane.

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23. An object tracking system as claimed in claim 3 and wherein said antenna of each ID tag comprises an inductive loop and wherein each of said sensors includes an inductive loop, said inductive loops of each ID tag aligning with said inductive loop of a sensor when the object to which said ID tag is attached is disposed in the receptacle associated with the sensor, the radio frequency transmission of said ID tag being inductively coupled to said sensor.

24. An object tracking system as claimed in claim 23 and wherein the inductive loop of each ID tag is received within the inductive loop of a sensor when the object to which the ID tag is attached is inserted within the receptacle 5 corresponding to said sensor.

25. An object tracking system as claimed in claim 23 and wherein the inductive loop of each sensor is received within the inductive loop of an ID tag when the object to which the ID tag is attached is inserted within the receptacle 10 corresponding to said sensor.

26. An object tracking system as claimed in claim 23 and wherein the inductive loop of each ID tag is juxtaposed the inductive loop of a sensor when the object to which the ID tag is attached is inserted within the receptacle 15 corresponding to said sensor.

27. In an object tracking system wherein objects to be tracked are provided with ID tags storing codes identifying the objects and the codes of objects present at a location are read by a reader for determining the presence or 20 absence of objects at the location, the improvement wherein the stored codes are conveyed to the reader through radio frequency transmission.

28. The improvement of claim 27 and wherein the radio frequency transmissions are conveyed to the reader by means of an antenna associated with 25 each ID tag and at least one antenna associated with the reader.

29. The improvement of claim 28 and further comprising a plurality of receptacles at the location, each receptacle configured to receive one of the objects.

30. The improvement of claim 29 and each receptacle has an associated reader and each reader is provided with an antenna for receiving the code transmitted by the ID tag of an object disposed in the corresponding receptacle.

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31. The improvement of claim 30 and wherein the antenna associated with each ID tag comprises a pair of capacitive plates and the antenna associated with each reader comprises a pair of capacitive plates positioned to align with the capacitive plates of the ID tag of an object disposed in the receptacle corresponding to the reader.

32. The improvement of claim 30 and wherein the antenna associated with each ID tag comprises an inductive loop and the antenna associated with each reader comprises an inductive loop positioned to align with the inductive loop of the ID tag of an object disposed in the receptacle corresponding to the reader.

33. A method of determining the absence or presence of objects at a location, the method comprising the steps of:

20 (a) providing each of the objects with a code identifying the object;
(b) periodically transmitting the codes of objects present at the location by radio frequency transmission;
(c) receiving the transmitted codes by radio frequency reception; and
(d) determining based on the received codes which objects are present at the location and which objects are absent from the location.

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34. The method of claim 33 and wherein step (a) comprises attaching a radio frequency identification (RFID) tag to each object to be tracked.

35. The method of claim 34 and wherein step (b) comprises providing an array of readers at the location, each reader configured and positioned to receive the radio frequency transmission of one of the objects present at the location.

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36. The method of claim 35 and wherein the radio frequency transmissions of the ID tags are conveyed to the readers through capacitive coupling.

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37. The method of claim 35 and wherein the radio frequency transmissions of the ID tags are conveyed to the readers through inductive coupling.

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38. The method of claim 35 and wherein step (b) comprises sequentially activating the readers and receiving a code if an object associated with the reader is present or receiving no code if an object associated with the reader is not present.

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39. The method of claim 38 and wherein step (d) comprises providing a controller coupled to receive and interpret codes received by the readers and further comprising the step of determining the presence and location of an object if the objects code is received and determining that the object is absent if no code is received.

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40. The method of claim 39 and further comprising the step of logging the determinations in order to track dynamically the removal and replacement of objects at the location.